

## Falls in the Elderly

FALLING REPRESENTS A MAJOR HEALTH and socioeconomic problem with an estimated cost of \$6 billion per year in the United States. It is the leading cause of death due to accidents among those 75 years of age or older. For every fall leading to death there are about 20 that result in hip fractures, accounting for at least 185,000 fall-related hip fractures per year. These fractures result in 40% of admissions to nursing homes. In the community among independently functioning older adults, one of three persons aged 65 years or older falls at least once a year.

Most falls do not result in serious injuries, but such episodes often lead to an increased fear of falling among the elderly, with a loss of self-confidence and a less active lifestyle.

Factors that contribute to falling include impairments of the vestibular, visual, musculoskeletal, or proprioceptive systems that may be the result of intrinsic physiologic aging phenomena or deconditioning, cardiovascular or neurologic disorders, and impaired balance iatrogenically induced by medication. In a one-year prospective study of the relative risk of these potential hazards among 336 community-residing elderly aged 75 or older, the most important risk factors distinguishing the 32% who fell at least once were the use of sedatives (relative risk [RR] 3.1), previous falls (RR 2.5), lower extremity disabilities (RR 2.4), and a near-vision loss of 20% or more (RR 1.7). The risk of falling increased linearly with the number of disabilities.

The result of efforts directed toward reducing the incidence of falls is thus far inconclusive. It has been shown, however, that the severity of injuries resulting from falls can be reduced by educating community-residing older adults on how to recognize and exercise caution in hazardous situations such as sudden glare, dark halls, and carpeted stairs with worn tread.

Additional strategies for preventing falls may include exercise to improve strength and mobility, health education with nutrition guidelines to retard bone loss, and medication counseling.

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## Spinal Stenosis—What's New?

EXPERIMENTAL EVIDENCE regarding the pathophysiology of lumbar spinal stenosis has further defined the process in the central canal. The primary problem is venous stasis and spinal nerve root and dorsal root ganglia engorgement and edema. A low pressure is responsible for this and is rapidly reversible with the restoration of venous circulation, correlating well with neurogenic claudication. The spinal nerve root also is susceptible to entrapment in the lateral lumbar spinal canal, but no research has been done yet on the critical dimensions of this canal.

Central canal diameters considered to be critical are less than 130 mm<sup>2</sup>, with a normal range of 200 to 340 mm<sup>2</sup>. The cauda equina is protected by the dura until the central canal is narrowed to 75 mm<sup>2</sup>. Venous stasis in the root occurs at a 25% constriction with no structural histopathologic dam-

age and no clinical neurologic deficit. A 50% narrowing produces weakness and demyelination. With 75% constriction, severe root injury and cauda equina damage occur.

Structural changes do not determine the source of pain, and advances in electrophysiologic diagnosis have been made with dermatomal somatosensory evoked potential (SEP) testing. This allows a precise localization of the root level of intermittent neurologic dysfunction with only conduction block present. Root dysfunction due to venous stasis and transient conduction block is accurately detected by stress-SEP testing. Testing is done after a patient has walked until symptoms are produced. The sensitivity of this test is greater than twice that of electromyography, but polyneuropathy is not as well defined as with electromyography. Somatosensory evoked potential testing allows a rapid noninvasive test to differentiate neurogenic from vascular intermittent claudication.

Precise neurodiagnostic testing serves as a guide to accurate surgical decompression. Intraoperative SEP testing can assure adequate root decompression. Neurophysiologic testing provides a measure of root function that cannot be intimated from radiologic structural assessments.

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## Somatosensory Evoked Potentials in Cord and Root Diseases

SOMATOSENSORY EVOKED POTENTIALS (SEPs) for the stimulation of selected nerve trunks or areas of skin contained within dermatomes may be used for segmental localization of spinal cord impairment or for nerve root assessment. Segmental SEPs are scalp recordings taken over the appropriate topographic areas of the postcentral gyrus. An impairment is localized by selecting for stimulation those nerve trunks or areas of skin within dermatomes that are associated with specific nerve roots or cord levels under question.

Data on normal subjects have been reported for several segmental levels. Most studies have focused on lumbosacral or cervical level inputs. Our laboratory has collected normative data for cervical, thoracic, and lumbosacral dermatomes.

We have demonstrated the diagnostic usefulness of segmental SEPs by comparing the effectiveness of dermatomal SEPs and electromyograms in patients with lumbar spinal stenosis. Of 26 patients who met all criteria after computed tomography, myelography, or both, 25 (96%) had abnormal SEPs bilaterally. By comparison, only 15 (59%) showed bilateral abnormalities by electromyography, suggesting that segmental SEPs are more likely to detect the root levels that are involved in spinal stenosis. A similar percentage of abnormality (95%) by dermatomal SEPs was reported recently in a study of 20 patients with disc disease and lumbar

canal stenosis. These percentages are higher than those reported in earlier studies of lumbar radiculopathy, probably reflecting that the efficacy of segmental SEPs in identifying root abnormalities associated with spinal stenosis is greater than with disc disease.

In segmental cervical level analysis, both nerve trunk and dermatomal SEPs may be used. Some studies have reported that SEPs are helpful in diagnosing root disease and identifying sensory levels in quadriplegia, although not all would agree as to their use. It is probably reasonable to say that at the cervical level SEPs serve best as an adjunct to other electrodiagnostic studies.

At the thoracic level, it was found that in two thirds of 37 patients studied, the level of conduction impairment was better located with thoracic dermatomal SEPs. Although more study of segmental SEPs needs to be done at the thoracic level as well as cervical and lumbar levels, these SEPs hold promise for a useful, noninvasive test of cord and nerve root function.

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## Objective Measures of Lumbar Strength

BACK PAIN is the most frequent cause of limited activity and lost time from work for persons younger than 45. About 80% of people will suffer at least one attack of significant back pain in their lifetimes, and 90% to 95% will recover within three months. The small percentage of patients who do not recover account for more than 80% of the medical costs for all patients with back pain. As back pain becomes chronic, the results of treatment decline dramatically. After two years less than 10% of patients will return to work or to moderately strenuous activities no matter what treatment is given.

Rest, medication, passive symptomatic physical therapy, and surgical therapy—in properly selected cases—are common early treatments. For patients for whom these treatments initially fail, however, prolonged bed rest, increased doses of medication, more hot packs, and a second operation have all been shown to aggravate rather than alleviate chronic pain.

Epidemiologic studies showed a tenfold increase in back injuries for the least fit firefighters compared with the most fit of that same group. A study using isometric strain gauge testing of strength showed that the incidence and severity of work-related lifting injuries were directly related to a worker's relative strength compared with the job requirements. In 1981 the National Institute of Occupational Safety and Health published guidelines for materials handling that included strength testing for workers who were asked to lift more than light loads close to the body.

The first isokinetic (constant speed) devices for low back

testing and strengthening reached the market five years ago. Normative data on trunk flexor-extensor strength in normal persons and in those with back injuries became available. Studies showed that a population with chronic low back pain had significant deconditioning in back extensors and flexors and that a ten-week treatment program using strengthening exercises, gym equipment, and simulated work activities could objectively increase strength and return workers to their original jobs. A control group treated with standard methods had half the success and twice the long-term costs. Objective measures of the body's ability to perform certain functional tasks were found to be more helpful than the patients' subjective reports of pain.

Subsequent studies have confirmed that patients with and without operations showed substantial benefits from education, training, and strengthening when the pretreatment deficits could be objectively quantified and when progress during treatment could be followed objectively. The initial isokinetic testing is most commonly combined with a half- to two-day tolerance testing of a simulated work environment (physical or functional capacity evaluation). Subsequent testing during and after treatment gives a clinician useful information to guide treatment and to determine a return to work or vocational rehabilitation status.

Isokinetic strength measurement is not in any way diagnostic of the underlying pathologic condition. Deficits in strength and endurance in patients with no definable disorder may be similar to those in patients with severe disease. The data are reproducible, with most patients showing 10% to 25% variability during subtests of a single test. Patients can be trained, however, to accurately reproduce submaximal effort. Inconsistent test results (varying more than 25%) are seen in patients with submaximal effort, elaborated pain drawings, elevated scores on the Minnesota Multiphasic Personality Inventory, "ratchety" give-way weakness, or inconsistent straight-leg raising (positive Waddell's signs). Patients with a notable functional overlay often refuse conditioning programs and do not show incremental objective increases in strength.

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## Self-Defense for People With Disabilities

BECAUSE DISABLED PERSONS are often perceived to be powerless, helpless, and unable to protect themselves, they are often targets for violent crime, including homicide, assault, rape, and robbery. Recent studies have documented that elder abuse is most widespread among elderly people who have physical or mental disabilities, that about 100,000 disabled women annually are victims of rape, that wife abuse is an especially widespread problem in the deaf community, and that there is a significantly increased incidence of physical and sexual abuse of children with developmental disabilities.

Although people with disabilities may have certain limitations, such as vision, hearing, speech, or mobility, they are usually able to develop other capabilities and to draw on available resources to protect themselves. Underestimating a patient's capabilities can be as devastating as overesti-